Testing inter-teeth variability in adult individual age-at death estimate using cementochronology (TCA)

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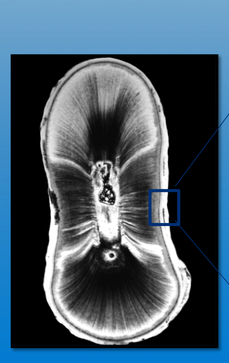
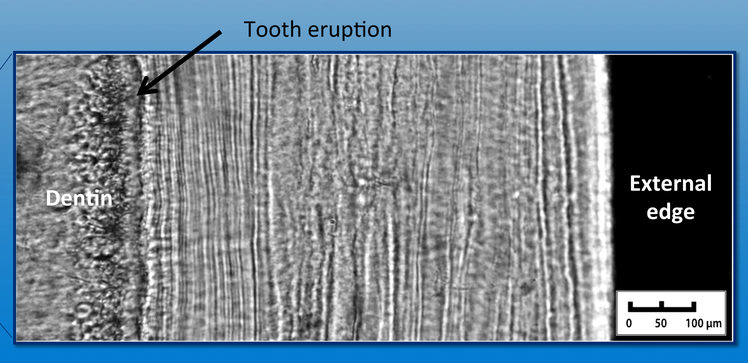
Introduction

Do all teeth of one individual indicate the same age?

- Variability of cementum only mentioned by 2 studies:
  - Charles *et al*. (1986): 43% between canines and premolars
  - Wittwer-Backofen *et al*. (2004): "no consistent high error"



Root cross section
X25



Band of cementum of a lower right lateral incisor.
Male, 55 years. X200

Objectives

Studying intra-individual variability of the dental cementum

- **Repeatability and reproducibility of counts**
- **Between dental classes**
- **Between teeth of one individual**

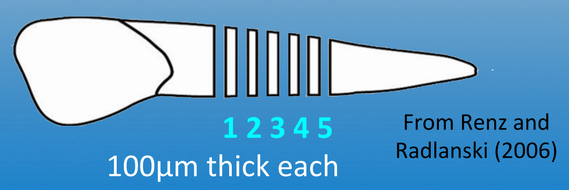
Materials and Methods

- **51 modern single-rooted teeth**
- **15 individuals** (39 – 81 years old)
- Central and lateral incisors, canines and premolars
- Multiple extractions from 2 to 12 teeth per individual

Protocol:

Preparation
- Anonymisation of teeth and sections
- Embedding teeth in epoxy resin

Sectionning



100µm thick each

From Renz and Radlanski (2006)

Counting
- Manual
- Area with the **largest number** of lines
- **Three counts** per tooth minimum

Statistical tests:

- Intra and inter-observer variability
- Link between error and tooth class (Kruskal-Wallis test + paired comparison)
- Average and maximum number of counted lines

Results

- 11 teeth excluded
  - Fragility
  - Unreadable
  - Insufficient number of counts (< 3/5)
- 4 individuals represented by 1 tooth

Unreadable cementum band. X50

Intra and inter observer variability

Intra observer	Inter observer
0.76	0.60

No link between error and class of teeth (p> 0.05)

Between teeth of one individual

Sample: 36 teeth of 10 individuals

- Using maximum of the age estimations:
  - Average deviation per individual:

2 – 13 years

  - Minimal and maximal deviation per individual:

0 – 26 years

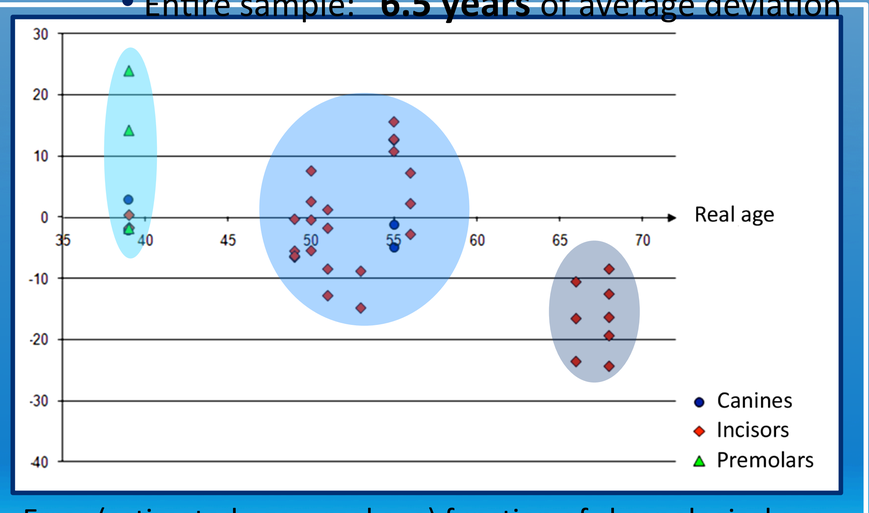
  - Entire sample: **6.5 years** of average deviation

Between dental classes

Sample: 40 teeth of 14 individuals

Average error	
Maximum of the age estimations	Average of the age estimations
2.64 years	8.43 years

- Incisors (n=33) – lowest errors with:
  - **Maximum** of the estimations
  - **Mandibular central incisors**



Error (estimated age – real age) function of chronological age by teeth classes

Discussion

- Repeatability and reproductibility of counts: **"good" coefficients (0.76 and 0.60)**
- **Maximal** estimation of age is more accurate than the average one
- *Between dental classes:*
  - Age structure: overestimation of age of younger adults and underestimation of age of older adults
  - **Mandibular central incisors** : the lowest error
- *Between teeth of one individual:*
  - Average deviation: **6.5 years** (acceptable; similar to other methods)
  - **Up to 26 years** (**premolars** known to be problematic)

Conclusion

- **Proved presence of intra individual variability between dental classes *AND* between teeth of one individual, sometimes very high (26)** → protocol to improve further
- **Maximal number of incremental lines provides more accurate and reliable estimations of age**
- Prospects: greater number of teeth, intra tooth variability, sexual and pathological influences